

# EXPLORING TEACHER USE OF AN ONLINE FORUM TO DEVELOP GAME-BASED LEARNING LITERACY

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## ABSTRACT

Game-based learning researchers have emphasized the importance of teachers' game literacy and knowledge of pedagogical approaches involved in successfully adopting an instructional approach (Bell and Gresalfi, 2017). In this paper, we describe findings from an online resource that teachers used to generate a repository of games for use both during their involvement in a Masters in Learning Technologies program and after the completion of the program. We argue that such a repository providing information on games in terms of their technology, pedagogy, and content may prove useful for teachers searching for games to align with their area of practice. This paper presents a descriptive analysis of a sample of 82 posts posted from September 2010 – November 2016 to demonstrate participants' emerging proficiency in assessing games for their technological, pedagogical, and content-related affordances and constraints (as supported by the Game Network Analysis (GaNA) framework) (Shah & Foster, 2015). The paper also presents a case example to illustrate a forum user's developing game literacy and the community and contextual factors that influence post content. We conclude with implications for future research.

## KEYWORDS

Game-based learning, Game Network Analysis, teacher development, online forums

## 1. INTRODUCTION

Serious games and games for learning have acquired greater mainstream acceptance as tools for knowledge, skill development, and behavioral change in students (Boyle et al., 2016). However, meta-analyses of game-based learning studies stress that the involvement of teachers can support meaningful learning through games, particularly through their expert intervention as content and pedagogical experts both in general and in partnership with the game being used (Clark et al., 2015; Wouters et al., 2013; Young et al., 2012).

For such integration to occur, Hanghøj (2013) stresses the need for teachers to develop both game literacy and skills in game-based learning curricular design and implementation. Teacher analysis of existing games for their pedagogical, technical, and content-related affordances and constraints (as part of GaNA) has been argued as a necessary prerequisite to game integration (Foster, 2012), particularly so that educators may determine whether a game is appropriate for their respective contexts (Foster et al., 2011). Examination of teachers' existing game selection processes also reveals that peer support, advice, and education play a key role; "what other teachers say about a game" was ranked as the biggest influence on game selection by teachers using GBL (Takeuchi and Vaala, 2014). Furthermore, teachers' limited knowledge of games has fueled their reluctance to use games in their instruction (Rice, 2007). Nonetheless, aside from small-scale in-person interactions, few structures or resources exist to support teacher development of game literacy and pedagogy (Ruggiero, 2013; Takeuchi & Vaala, 2014). Online websites or forums might serve this function, and promote wider dissemination of expertise by teachers and for teachers; however, these too are rare.

In this paper, we used the Game Network Analysis (GaNA) theoretical framework to create and examine the outcomes of the 'Learning in Game-Based Environments Web Resource' for teachers and professionals partaking in a graduate program on Learning Technologies. Game Network Analysis (GaNA) is a combination of analytical and pedagogical frameworks developed to aid teachers, researchers and designers in adopting game-based learning (GBL). The following work offers an introduction to the online resource and its purpose, followed by a description of data collection and analysis procedures to descriptively explore

manifestations of teacher game literacy using GaNA as an analytical framework. First, a descriptive analysis of a sample of 82 student forum posts made on the web resource offers insight into participants' emerging proficiency in assessing games for their technological, pedagogical, and content-related affordances and constraints (as supported by GaNA) (Foster et al., 2015). The paper then presents a case example to illustrate an individual forum user's developing game literacy and the community and contextual factors that influence post content. We conclude with implications for future research on this topic, and offer preliminary suggestions for the design of future resources that develop teachers' game literacy.

## 2. GAME NETWORK ANALYSIS

Game Network Analysis (GaNA) is a combination of analytical and pedagogical frameworks developed to aid teachers, researchers and designers in adopting game-based learning (GBL). Analytical elements of GaNA support consideration for the ecological conditions (technological, pedagogical, and content-related) that influence the integration of game-based curricula in formal and informal learning contexts (Foster et al., 2015). The game integration frameworks in GaNA include the Play, Curricular activity, Reflection, Discussion (PCaRD) model (Foster & Shah, 2015b), and the inquiry, communication, construction, and expression (ICCE) framework (Foster & Shah, 2015a), which offer a process for employing game-based learning in classrooms in a given context (Shah & Foster, 2015).

## 3. THE LEARNING IN GAME-BASED ENVIRONMENTS WEB RESOURCE

The image shows a screenshot of a web resource titled "Learning in Game-based Environments Web Resource". The page has a navigation bar with links: Home, Welcome, Videos, Game-based Learning Courses, Bios, Events, Games, News articles, Resources, and Uncategorized. The main content area is titled "Welcome" and contains a message from the creator, a list of instructions for adding games and news articles, and a note about registration. To the right, there are two sample posts. The first post is titled "Econauts - Examining Ecological Relationships" and features a game cover for "ECONAUTS". The second post is titled "Oiligarchy" and features a game cover for "OILIGARCHY".

Figure 1. The homepage and sample posts from the Learning in Game-Based Environments Web Resource

The 'Learning in Game-Based Environments Web-Resource' (see Figure 1) was developed as part of an online Masters in Learning Technologies program for students taking courses in the game-based learning concentration at an urban private university in a Northeastern city in the United States. The web resource was intended to serve as a repository of videos about digital media, games for learning, and news articles about games, play and learning that would be continually updated, mostly by students and occasionally by the course instructors. The purpose of this virtual space was to serve as a resource portal for students to access both during the courses and after the courses had ended, and consists primarily of a forum where students were encouraged to contribute posts about games, links to news articles, or other game-based learning resources for peers.

The majority of these forum posts describe existing games, and their potential utility for game-based learning contexts. As part of class activities, students are encouraged to post games to the forum that had not appeared previously in the posting lists; thus, the majority of game analysis posts are unique. This tool also hosts an online discussion forum that has been active since September of 2010 (7 years), that currently contains over 250 original posts with over 280 response comments made by students with experience in education, game design, business, and other areas of career or academic expertise.

Instructors invited students to share brief descriptions of games and explain why they were or were not interesting, with posting guidelines kept intentionally open-ended to encourage students to share whatever information they found relevant. Students received instructions stating “For the games – provide a brief description of the game by age group target, an image, URL, creator/designer/publisher, content – school content and other, role of pedagogy and the genre of the game, and why this games is interesting or not. For news articles – provide a summary of the article (your discretion), URL to the article, where it was published, and the author of the article.”

Resources like the Learning in Game-Based Environments have only recently been introduced. For example, Legends of Learning is a web-based platform that allows teachers/parents to create a playlist of learning games. Common Sense Media, a non-profit organization, offers a review of variety of media (e.g. games, TV shows, films) for parents and teachers to make choices for use with children and youth. The Learning in Game-Based Environments Web-Resource is unique in that it was created exclusively for educators and was tied to professional development as courses in the graduate program. Additionally, the web resource has been active for a long time, resulting in a large pool of resources for and by teachers and professionals. Thus, examination of sites that promote, develop and disseminate teacher-to-teacher game analyses is warranted, to better understand how such tools serve current and future educators.

### 3.1 Research Sampling and Analysis

A stratified random sample of forum posts describing games was collected across the 75 months during which the forum has been active; 33 months did not contain posts on games for education. Of the remaining 42 months, one to two posts on games was randomly sampled from each month and examined for student game analysis in terms of a game’s technological, pedagogical, and content-based affordances and constraints. Months with no posts on games for learning were spread throughout the web resource, likely signifying the gaps between classes in which students contributed posts. Several posts contained multiple discrete descriptions of individual games; text from these posts was separated by game into individual data entries, to assess game literacy development for each described game. The resulting sample consisted of 82 games.

A detailed codebook was developed to analyze posts for the inclusion of specific types of information relating to elements of a game’s technology (game platform), pedagogy (game genre), and elements of content (subjects or skills) (see Table 1). The objective of the analysis was to identify the extent to which participants demonstrated game literacy (i.e. were able to describe a game in terms of technological, pedagogical, and content affordances and constraints). Code lists for platform, genre, content, and skill were modeled after those used by the website Common Sense Media to categorize game reviews geared toward parents, educators, and technology advocates.

Table 1. Codes for Analyzing the Learning in Game-Based Environments Web-Resource. Codes were developed based on those hosted at <https://www.commonssensemedia.org/game-reviews>

Question	Label	Value	Measure
What is the genre of the game?	Genre	01 – Educational 02 – Action/adventure 03 – Roleplaying ... 26 – Other 27 – Multiple genres	Nominal
What content (subject area) does this game focus on?	Subject	00 – Information not provided 01 – Language and reading 02 – Math 03 – Science ... 07 – Other	Nominal
What content (skills) does this game focus on?	Skill	00 – Information not provided 01 – Thinking and reasoning 02 – Creativity 03 – Self-direction ... 10 – Other 00 – Information not provided	Nominal

A team of 5 researchers completed three rounds of cross-coder comparison using the codebook, at which point a moderate level of agreement was reached ( $k = .549$ ), and coding of the resulting sample of 82 game posts commenced. Following descriptive statistics to characterize emerging teacher game literacy, chi square tests were calculated across each pair of codes to explore patterns of co-occurrence across descriptions of technology, pedagogy, and content.

In addition, elements of text were deductively coded for discussions of a game's technology, pedagogy, and content, providing a body of text vignettes organized by game analysis elements. These categories were then examined using open and axial coding techniques to reveal emerging qualitative themes (Glaser and Strauss, 1967) to further inform how posters discuss and analyze games. Findings present a descriptive picture of students' game analysis processes as part of GaNA – a preliminary examination that will support future in-depth qualitative and quantitative analysis.

## 3.2 Findings

### 3.2.1 Game Objectives

The majority of the game descriptions (58, 71%) reported game objectives in varying levels of detail. Some posts detailed game objectives in terms of what players might learn or experience. For instance, a post on *Diabetic Dog Game* described it as “a simulation game that teaches children how to take care of animals.” Some posts instead detailed the objectives of gameplay, or objectives for game completion:

You have to find a way to get the hamburger to the hungry cat by popping balloon like objects that are blocking the hamburger's path. You also have to keep the hamburger from falling onto an electrified grid which burns it to a crisp. (*Cat Around the World*, 04/2013)

Some posts also merged game objectives with student learning objectives, as demonstrated in the following example:

You Make Me Sick is a game for middle school kids (ages 11-14) to teach them about the process of infection, pathogens and how infections occur. The game is made up of parts: first teaching students on the habits and weaknesses of a human, then creating an evil pathogen, and finally playing a short game in battling the pathogen against immune cells. (*You Make Me Sick*, 04/2011)

### 3.2.2 Technological Affordances and Constraints

In the majority of game descriptions (57, 71%), game platform information was not included in the post. Often, technological platforms were only explicitly detailed when they were particularly noteworthy in some way, such as when a game was hosted on multiple platforms:

The game is also great because you only need an internet connection to play. You can even download the game as an application for your iphone, which makes it available at your hands even more. (*Sporcle*, 09/2010)

In 59 of the 82 game descriptions (73%), a URL was provided, or references to the hosting website or descriptions of website play were included. This suggests a potential preference among posters for games distributed online through websites, or illustrates the likely abundance of such games. When posters detailed game technological affordances or constraints, technical features were often connected to pedagogical benefits from either the teacher or learner's perspectives, as demonstrated in an example below:

Thermometers are placed with pictures to represent high and low temperatures. Students can use them as a guide to which items get paired together. The name of the picture is also said out loud so students can learn more vocabulary and help figuring out what a picture is. (*Weather Surprise / Sid the Science Kid*, 02/2012)

### 3.2.3 Pedagogical Affordances and Constraints

In 57 cases (71%), posters provided some information regarding the genres of games. Post described games as educational (15, 19%), other (13, 16%), puzzle (11, 14%), multi-genre (5, 6%), roleplaying (4, 5%), strategy (4, 5%), simulation (2, 2%), action/adventure (1, 1%), and edutainment (1, 1%). Some pedagogical descriptions affirmed how the games could help educate players about specific skills or content. Some posts listed pedagogical benefits of the game for specific learning groups. Other posts described specific lesson plans or classroom activities in which other teachers could use the games:

The game allows for spelling word lists to be created. I downloaded the game and created basic sight word lists for my 5-year-old son. I made lists like "body parts" and entered head, arm, leg, etc. and "colors" with red, blue, green, etc. I then played the game and allowed my son to play the game. We both found the game play to be very simple, requiring no real instructions to get started. Without reading, it is simple enough to understand the game play and process. The game tracks statistics of how much time is spent playing the games and percentage of correct spellings for each word list. (*Spelling Monster*, 08/2014)

### 3.2.4 Content-based Affordances and Constraints

In 49 cases (60%), posters provided information on the subjects covered by the games in each description. The games focused on math (10, 12%), science (9, 11%), other areas (9, 11%), social studies (7, 9%), language and reading, (6, 7%), multiple areas (6, 7%) or hobbies (2, 3%). In addition to games that were connected to a variety of subject areas including science, social studies, language and reading, hobbies, engineering, and personal finance, three posts also made explicit reference to multiple content areas, as demonstrated in an example below:

The beautiful thing about Sporcle is that it is filled with content. It ranges from everything from Geography to Entertainment. If you want to use your math skills, you can search for math games. If you want to test your video game knowledge, you can do that as well. (*Sporcle*, 09/2010)

Thirty-three posts (40%) contained information on the types of skills embedded in or connected to each game. Specifically, posters described their games as facilitating "other" skills (11, 13%), thinking and reasoning, (8, 10%), responsibility and ethics (3, 4%), tech skills (3, 4%), multiple skills (3, 4%), self-direction (2, 2%), communication (2, 2%), and health and fitness (1, 1%). Combinations coded for games connected to multiple skills ranged from responsibility and ethics and health and fitness (*Diabetic Dog*

*Game*) to thinking and reasoning and tech skills (*Code Monster*). In several cases, posters explicitly highlighted the multiple skills developed through gameplay as a game asset:

So this game not only teaches how to take care of a dog, but also money management and how to balance a diabetic's diet. These lessons could also be applied to a non-diabetic's diet. It can teach responsibility and also time management. It is also easier than a real dog and it is free. This learning experience is very interactive and it allows children to explore what it might be like to live with and take care of a diabetic. (*Diabetic Dog Game*, 03/2011)

### 3.2.5 Additional Themes

Additional themes that arose in game posts included poster's personal opinions and experiences with each game, as demonstrated in the following examples:

What attracted me to this game was first the concept – it seems like a great idea for a game, to utilize biology and the bodies defense system. (*Immune System Defence Forces*, 11/2011)

I found that not only was the game animal shelter a good game that allows children to see what it is like to take care of pets but that it can be for both girls and boys. One day I was playing this game, and my nephew wanted to give it a try. For an 8 year old, it was stimulating because it required a sense of responsibility. Although he had little experience with taking care of animals this game, gave him a look into all the things that are required to house pets. (<http://www.123-games.net/games/animal-shelter>, 01/2012)

Given the importance of peer reviews in teachers' game selection, it is likely such endorsements may carry particular weight for other educators. Another common theme involved the provision of information on the background, design, or other history of the game. This suggests posters may have valued background information on game development and release as useful or interesting to peers. For example:

It has been downloaded over 25 million times and was a runner up in the IGN Game of the Year 2012 awards for 'Overall Best Strategy Game'. Overall, it was the 15th most downloaded paid iPhone game of 2012 in the U.S. and the 5th most downloaded paid iPhone game of 2013 in the U.S. In February 2014, Ndemie Creations released Plague Inc: Evolved, for PC, Mac and Linux onto Steam. The game continues to have an active community and is regularly updated. (*Plague Inc.*, 11/2014)

For 7 out of the 37 posts (19%), other site users left one or more comments on the posts. Teachers who had previous experience with the posted game, or saw particular relevance of the tool in their specific contexts, made up the majority of posted comments in 2010 through 2012. Comments made in the 2015 cohort typically contained deeper analyses of the games themselves, as the group played the games and offered affirmations and critiques.

### 3.2.6 Variable Associations

Chi square tests explored associations between the presence of post information on technology, pedagogy, and content; findings indicated statistically significant associations between a posts' inclusion of classroom subject and game objective ( $\chi^2(1, 82) = 5.068, p = 0.025$ ), and subject and skill ( $\chi^2(1, 82) = 5.270, p = 0.022$ ) (see Table 2). This informs how posters might be conceptualizing and discussing game content affordances and constraints – describing a learning objective, detailing classroom subject alignment, and then relating the game to teachable skills.

Statistically significant associations also emerged between game objectives and associated URLs ( $\chi^2(1, 82) = 5.319, p=0.021$ ), which informs how posters might conceptualize and discuss technological features (if and when they do). A typical post might include a brief description of how to play and win the game, followed by a link to access it, but more often may not develop a technological assessment further to consider things like game platform.

Table 2. Chi Square tests of associations between technology, pedagogy, and content variables

Data pair	$\chi^2$	p-value
<b>Subject_objective</b>	<b>5.068</b>	<b>0.025</b>
Subject_platform	3.638	0.056
Subject_genre	3.067	0.080
<b>Subject_skill</b>	<b>5.270</b>	<b>0.022</b>
Subject_url	5.270	0.438
Objective_platform	0.704	0.402
Objective_genre	0.224	0.636
Objective_skill	3.500	0.061
<b>Objective_url</b>	<b>5.319</b>	<b>0.021</b>
Platform_genre	0.550	0.458
Platform_skill	1.144	0.285
Platform_url	0.118	0.731
Genre_skill	0.775	0.379
Genre_url	0.004	0.949
Skill_url	2.778	0.096

No statistically significant associations were found between game genre and any other category, suggesting a potential disconnect between inclusion of game genre (which involves usually one word or less) and other text discussions of pedagogical, technological, and content-based affordances and constraints. This suggests the need to build teacher awareness of how genre influences pedagogy (how the game teaches), and the need for a qualitative exploration of how teachers do describe game pedagogy. The following case example illustrates how one teacher introduced technology, pedagogy, and content in her posts.

#### 4. CASE EXAMPLE

Kai (pseudonym) posted four games on the Learning in Game-based Environments Resource – two in October of 2015 and two in November of 2015. In October, Kai posted about *The Migrant Trail* and *Rolling Fall*, while in November, she posted about the games *Superbetter* and *Yousician*. The game-based learning class asks students to make two posts to the forum resource, suggesting Kai's voluntary posting to the forum beyond the mandatory minimum. Kai was selected as an instrumental case example due to this higher number of posts, which afforded greater insight into her developing game literacy over time; though posts varied by student in terms of length and content, Kai's posts were chosen as representative of "average" game posts in terms of length and level of detail.

Kai described *The Migrant Trail* as a "text-based adventure game," *Rolling Fall* as a "puzzle game," and *Yousician* as an "app game," but did not share a genre for *Superbetter*. Kai described *Superbetter* as "a digital version of gamified life." As definitions of gamification often distinguish such tools from traditional games, Kai may not have known how to distinguish *Superbetter* by game genre.

In most cases, Kai did not explicitly describe the platforms needed to play these games. However, in all four cases, Kai provided a URL or mentioned a game website, which suggests that all of the games were hosted online and accessible with any platform that could access the Internet. Kai's posts also encouraged readers to explore the game sites through supportive texts (i.e. "But don't take my word for it. Go have fun killing zombies.").

Kai's post on *Yousician* offered greater detail on technological game affordances as compared to her other posts; she described it as a "web or mobile-based app game," further emphasizing that this game was hosted on multiple platforms. She also described how "the game uses the microphone of your computer and analyzes the real sounds coming from a real guitar to award...points," stressing how the technological setup of this game (as compared to *Guitar Hero*) could develop real-world musical skill.

Kai provided detailed information on the pedagogical affordances of each game in her posts. For *The Migrant Trail*, she offered in-depth descriptions of how the game promotes understanding of different perspectives and complex immigration issues by sharing the stories of key characters:

The game can be played from the perspective of migrants as well as border control agents, which lends a level of complexity to the issue...The player is confronted with the personal story of each migrant, which humanizes them and helps the player understand why each migrant feels it is necessary to make the incredibly dangerous journey.... Playing from the perspective of the border patrol agents, is significantly less challenging and engaging, however, its main purpose is to highlight the magnitude of the crisis for migrants trying to cross the border...You also get to read the agents' bios, which explains their motivation and diversity.

Kai also provided some information on the content knowledge and skill development supported by each of these games. For instance, in her post on *Rolling Fall*, Kai listed the specific physics constructs demonstrated by the game, such as “energy conservation,” “parabolic kinematics,” and “rotational equilibrium,” and described how the game could be integrated into a high school math unit.

Several additional posting themes emerged during analysis of Kai's posts. Kai described specific age groups, demographics, or contexts in which each game could serve an educational purpose. In her post on *Rolling Fall*, for example, Kai identified herself as a physics teacher and provided specific curriculum ideas for using the game based on student age group:

Younger students (late elementary, early middle school) would benefit from playing this game just to gain a feel for the physical world and how it works. Older students (early high school) could play this game and tie it into real-world experiments, to learn the mathematics behind what they are playing with.

Kai also regularly integrated other elements of her personal experiences with and around these games into her posts, detailing her personal experiences playing or using the games as context for her endorsements:

I found out about this game from a friend in a support group that I belong to, as we both have a vascular brain anomaly that can cause some issues like a traumatic brain injury. I decided to give it a go (I'm playing in 2 different challenges at the moment). I love it so much, I recommended it to my sister who deals with depression (who also loves it). I also recommended it to my colleagues to use in middle school homeroom classes to help students work on motivation and self-acceptance.

In another post that Kai made to the forum (where she shared a non-game resource), she described the forum as “a community of people who value games.” This understanding of the nature purpose of the forum is perhaps reflected in the particularly active peer responses her posts engendered. Her game descriptions merged practical discussions of each game's utility for learning with relatable personal experiences as a teacher and game user. While demonstrations of Kai's game literacy varied in terms of the volume and detail of information presented on technological, pedagogical, or content-related issues, her emphases on one or more of these areas perhaps reflects an profound understanding of what information the community might find immediately relevant about a game (i.e. *Yousician* might require an initial focus on technological setup).

## 5. CONCLUSION

A Descriptive analysis of the Learning in Game-Based Environments Web Resource revealed gaps in representation of technological, pedagogical, and content-based affordances and constraints across the sampling of game posts, most notably in discussions of technology. Posts that provided a comprehensive analysis were rare; more often, a poster would prioritize discussion of unusual or noteworthy elements over others (i.e. a game played on a PlayStation 3 warranted more explicit discussion of technology). While game posts often shared detailed discussions of technology, pedagogy, or content, the inclusion of more specific prompts or educator supports could promote comprehensive game analysis discussions.

Kai's case example illustrates how a single student's posts might vary based on their integration of game analysis constructs due to contextual factors such as characteristics of the game itself, the poster's opinions and personal experiences, and perhaps on the poster's perceptions of what the community finds useful. A fruitful avenue of future research might explore how users decide and justify what information to include in their discussions of games to further illuminate teacher game literacy practices.



Further development of this research will also expand the sample to test for statistical differences between posters that did and did not include elements of content, pedagogy, or technology. These and future findings offer potential insights to educators working to support game literacy and pedagogy in future teachers. Just as Young et al. (2012) argued for the creation of an educational video game repository for use in research follow-up and replication, such a tool could offer manifold benefits to educators looking to develop game implementation skills and searching for games to use in their classrooms. Given the rarity of such a resource and its potential to help fill implementation gaps, an examination of this existing online repository serves as a useful example for the development of future tools and resources for teacher-driven games education and skill development.

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